# S. P. Mandali's

# Ramnarain Ruia Autonomous College
### *Affiliated to Mumbai University*



# Program: TYBSc

# Program Code: (Computer Programming and System Analysis) RUSACMAT

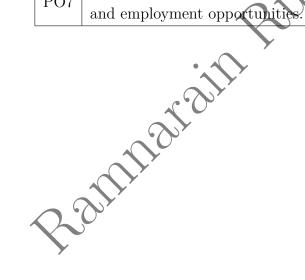**(Credit Based Semester and Grading System for Academic Year 2023-24)**

# Graduate Attributes

| GA | GA Description-A student completing Bachelor's/Master's Degree in Mathematics program will be able to: |
|---|---|
| GA1 | Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science. |
| GA2 | Evaluate scientific ideas critically, analyze problems, explore options for practical demonstrations, illustrate work plans and execute them, organize data and draw inferences. |
| GA3 | Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools. |
| GA4 | Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results. |
| GA5 | Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner. |
| GA6 | Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society. |
| GA7 | Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it. |
| GA8 | Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner |

# Program Outcomes

| PO | Description-A student completing Bachelor's Degree in Science/Arts program in the subject of Mathematics will be able to: |
|----|----------------------------------------------------------------------------------------------------------------------------|
| PO1 | Demonstrate fundamental systematic knowledge of mathematics and its applications in engineering, science technology and mathematical sciences. It should also enhance the subject specific knowledge and help in creating jobs in various sectors. |
| PO2 | Demonstrate educational skills in areas of analysis, algebra, differential equations, Graph Theory and combinatorics etc. |
| PO3 | Apply knowledge, understanding and skills to identify the difficult / unsolved problems in mathematics and to collect the required information in possible range of sources and try to analyse and evaluate these problems using appropriate methodologies. |
| PO4 | Fulfil one's learning requirements in mathematics, drawing from a range of contemporary research works and their applications in diverse areas of mathematical sciences. |
| PO5 | Apply one's disciplinary knowledge and skills in mathematics in newer domains and uncharted areas. |
| PO6 | Identify challenging problems in mathematics and obtain well-defined solutions. |
| PO7 | Exhibit subject-specific transferable knowledge in mathematics relevant to job trends and employment opportunities. |

# Program Outline

| Year | Sem | Course Code | Course Title | Credits |
|------|-----|-------------|--------------|---------|
| TYBSc | V | RUSACMAT501 | Computer Programming And System Analysis - I | 2 |
| TYBSc | V | RUSACMATP501 | Practicals based on (RUSACMAT501) | 2 |
| TYBSc | VI | RUSACMAT601 | Computer Programming And System Analysis - II | 2 |
| TYBSc | VI | RUSACMATP601 | Practicals based on (RUSACMAT501) | 2 |

# Course Outcomes

**Course Code:RUSACMAT501**
**Course Title: Computer Programming And System Analysis-I**
**Academic Year: 2023-24**

| CO | CO Description |
|---|---|
| CO1 | to write and run programs using PYTHON. |
| CO2 | to write and run programs using SageMath. |

# Detailed Syllabus

| Course Code/ Unit | Unit | Course/ Unit Title | Credits/ Lectures |
|---|---|---|---|
| RUSACMAT501 | I | Introduction to Python | 15 lectures |
| RUSACMAT501 | II | Advanced topics in Python | 15 lectures |
| RUSACMAT501 | III | Introduction to SageMath | 15 lectures |
| RUSACMAT501 | IV | Programming in SageMath | 15 lectures |

Unit 1: Introduction to Python

1. A brief introduction about Python and installation of anaconda.

2. Numerical computations in Python including squareroot, trigonometrical functions using math and cmath module. Different data types in Python such as list, tuple and dictionary.

3. If statements, For loop and While loops and simple programmes using these.

4. User-defined functions and modules. Various use of lists, tuple and dictionary.

5. Use of Matplotlib to plot graphs in various format.

Unit II: Advanced topics in PYTHON:

1. Classes in Python.

2. Use of Numpy and Scipy for solving problems in linear algebra and calculus, differential equations.

3. Data handling using Pandas.

Unit III: Introduction to SageMath

1. Sage installation and use in various platforms. Using SageMath as an advanced calculator.

2. Defining functions and exploring concept of calculus.

3. Finding roots of functions and polynomials.

4. Plotting graph of 2D and 3D in SageMath.

5. Defining vectors and matrices and exploring concepts in linear algebra.

Unit II: Programming in SageMath

1. Basic single and multi-variable calculus with Sage.

2. Developing Python programmes in Sage to solve same problems in numerical analysis and linear algebra.

3. Exploring concepts in graph theory and number theory.

## Distribution of topics for Practicals

| Practicals Based on Course : RUSACMAT501. Course Code: RUSACMATP501 | |
|---|---|
| Sr. No. | Practicals |
| 1 | Symbolic computations with Sympy package. |
| 2 | Plotting of various types of graphs using Matplotlib |
| 3 | User defined functions and classes in Python |
| 4 | Working with Numpy and Scipy |
| 5 | Plotting graphs using Sagemath |
| 6 | Linear Algebra using Sagemath |
| 7 | Manipulations with polynomials using Sagemath |
| 8 | Basic numerical methods using Sagemath |

**References:**

1. Hans Petter Langtangen (auth.)-A Primer on Scientific Programming with Python-Springer Berlin Heidelberg (2014)

2. Robert Johansson-Numerical Python. A Practical Techniques Approach for Industry-Apress (2015)

3. George A. Anastassiou, Razvan A. Mezei (auth.)-Numerical Analysis Using Sage-Springer International Publishing (2015)

# Modalities of Assessment

# Theory Examination Pattern

**(A) Internal Assessment -** 40% **40 Marks**

| Sr. No. | Evaluation Type | Marks |
|:---:|:---|:---:|
| 1 | Test | 20 |
| 2 | Assignment/Viva/Test/Presentation | 20 |
| **Total: 40 Marks** | | |

**(B) External Examination-** 60% **60 Marks**

1. Duration: These examinations shall be of **two hours duration**.

2. Theory Question Pattern

| Paper Pattern | | | | | |
|:---|:---:|:---|:---:|:---|
| **Question** | **Sub-question** | **Option** | **Marks** | **Questions Based on** |
| Question 1 | a | Attempt any one of the given two questions. | 15 | Unit-I |
| | b | Attempt any two of the given three questions. | | |
| | c | Attempt any two of the given three questions. | | |
| Question 2 | a | Attempt any two of the given three questions. | 15 | Unit-II |
| | b | Attempt any two of the given four questions. | | |
| | c | Attempt any two of the given three questions. | | |
| Question 3 | a | Attempt any one of the given two questions. | 15 | Unit-III |
| | b | Attempt any two of the given four questions. | | |
| | c | Attempt any two of the given three questions. | | |
| Question 3 | a | Attempt any one of the given two questions. | 15 | Unit-IV |
| | b | Attempt any two of the given four questions. | | |
| | c | Attempt any two of the given three questions. | | |
| **Total Marks: 60** | | | | |

# Practical Examination Pattern

**(A) Internal Assessment -** 40% **40 Marks**

| Sr. No. | Evaluation Type | Marks |
|---------|-----------------|-------|
| 1 | Journal | 10 |
| 2 | Project | 30 |
| **Total: 40 Marks** | | |

**(B) External Examination-** 60% **60 Marks**

1. Duration: These examinations shall be of **two hours duration**.

2. Practical Question Pattern

| Sr. No. | Evaluation Type | Marks |
|---------|-----------------|-------|
| 1 | Viva | 10 |
| 2 | Lab work based on first two units | 25 |
| 3 | Lab work based on last two units | 25 |
| **Total: 60 Marks** | | |

# Overall Examination and Marks Distribution Pattern
# Semester-V

| Course | RUSACMATP501 | | | RUSACMATP501 | | | Grand Total |
|--------|--------------|----------|-------|--------------|----------|-------|-------------|
| | Internal | External | Total | Internal | External | Total | |
| Theory/Practical | 40 | 60 | 100 | 40 | 60 | 100 | 200 |

# Course Outcomes

**Course Code:RUSACMAT601**
**Course Title: Computer Programming And System Analysis-II**
**Academic Year: 2023-24**

| CO | CO Description |
|---|---|
| CO1 | to write and run programs using SciLab. |
| CO2 | to typeset different kinds of documents using LATEX |

# Detailed Syllabus

| Course Code/ Unit | Unit | Course/ Unit Title | Credits/ Lectures |
|---|---|---|---|
| RUSACMAT601 | I | Introduction to SciLab | 15 lectures |
| RUSACMAT601 | II | Programming in SciLab | 15 lectures |
| RUSACMAT601 | III | Introduction to L<sup>A</sup>T<sub>E</sub>X | 15 lectures |
| RUSACMAT601 | IV | Presentation using slides and articles in L<sup>A</sup>T<sub>E</sub>X | 15 lectures |

Unit 1: Introduction to SciLab

1. Basic introduction to SciLab, using SciLab as an advanced calculator.

2. Defining vectors and matrices and basic operations.

3. Plotting graphs of 2D and 3D in various forms.

4. Exploring concept of calculus using SciLab.

5. Solving ODE in SciLab.

Unit II: Programming in SciLab

1. If-else conditions, loops, user defined functions etc.

2. Developing programs to find roots of algebraic and transcendental functions and solving systems of linear equations (Gaussian Elimination Method , Gauss-Jacobi Method and Gauss-Siedel Method).

3. Exploring applied linear algebra using SciLab ( eigenvalues, eigenvectors and various properties, applications to solve ODE, matrix factorization and its applications).

Unit III: Introduction to LATEX

1. Introduction,document structure - creating title, sections, table of contents, labelling.

2. Typesetting text - fonts, text colour, lists.

3. Tables, equations.

Unit II: Presentation using slides and articles in LATEX

1. Layout of page, cross references.

2. Footnotes, definitions

3. Page style, presentation slides.

| Practicals Based on Course : RUSACMAT501. Course Code: RUSACMATP501 | |
| --- | --- |
| Sr. No. | Practicals |
| 1 | Use of Scilab as a calculator |
| 2 | Plotting of various types of graphs using Scilab |
| 3 | Applied linear algebra using Scilab |
| 4 | Basic numerical methods using Scilab |
| 5 | Display titles and sectioning, table of contents, labelling, font colour, page colours etc. |
| 6 | Drawing tables and use of Maths environments |
| 7 | Defining new commands, use of boxes, using Graphics package |
| 8 | Making slides using beamer class |

**References:**

1. SciLab Textbook Companion For Higher Engineering Mathematics, B. S. Grewal.

2. SciLab Textbook Companion For Linear Algebra and Its Applications, D. C. Lay.

3. SciLab Textbook Companion For Numerical Methods, E. Balguruswamy.

4. Introduction to SciLab, Sandeep Nagar, Apress.

5. A guide to LaTeX, Kopka and Daly

# Modalities of Assessment

# Theory Examination Pattern

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| 1 | Test | 20 |
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2. Theory Question Pattern

| Paper Pattern | | | | |
|---------------|--------------|--------|--------|-------------------|
| **Question** | **Sub-question** | **Option** | **Marks** | **Questions Based on** |
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| | b | Attempt any two of the given three questions. | | |
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| Question 3 | a | Attempt any one of the given two questions. | 15 | Unit-III |
| | b | Attempt any two of the given four questions. | | |
| | c | Attempt any two of the given three questions. | | |
| Question 4 | a | Attempt any one of the given two questions. | 15 | Unit-IV |
| | b | Attempt any two of the given four questions. | | |
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| **Total Marks:** 60 | | | | |

# Practical Examination Pattern

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| Sr. No. | Evaluation Type | Marks |
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| 1 | Viva | 10 |
| 2 | Lab work based on first two units | 25 |
| 3 | Lab work based on last two units | 25 |
| **Total: 60 Marks** | | |

# Overall Examination and Marks Distribution Pattern
# Semester-VI

| Course | RUSACMATP601 | | | RUSACMATP601 | | | Grand Total |
|:---:|:---:|:---:|:---:|:---:|:---:|:---:|:---:|
| | Internal | External | Total | Internal | External | Total | |
| Theory/Practical | 40 | 60 | 100 | 40 | 60 | 100 | 200 |